Exhibit 11

UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF MASSACHUSETTS

ANNA V. KASHPER, individually, and as mother and next friend of Three Minors and as personal representative of the ESTATE OF KONSTANTIN M. KASHPER, Plaintiff, VS. TOYOTA MOTOR SALES, U.S.A., INC.; TOYOTA MOTOR CORPORATION; ENTERPRISE FM TRUST; ENTERPRISE FLEET MANAGEMENT; JOHN DOE 1; JOHN DOE 2 and JOHN DOE 3, Defendants.	C.A. No. 1:17-cv-12462-WGY

AFFIDAVIT OF WILLIAM W. VAN ARSDELL, PH.D.

I, William W. Van Arsdell, on oath depose and state as follows:

1. I am a professional mechanical engineer and the principal engineer of Engineering Principles, LLC.
2. I have been retained as an expert by Toyota Motor Sales, U.SA., Inc. in this case.
3. Attached as Exhibit A to this affidavit is a true and accurate copy of my expert report as well as a copy of my curriculum vitae, which describes my education, background, experience, and publications.
4. The statements made in this report are true and accurate.
5. The findings and opinions stated in the report are true and accurate, and are based upon my knowledge, education, training and expertise, my review of the materials described in my report, and my investigation and work done in this case.

6. The findings, conclusions, and opinions expressed in the report are held by me to a reasonable degree of engineering and scientific certainty.

Signed under the pains and penalties of perjury this 18TH day of October, 2018.

William W. Van Arsdell, Ph.D.
Principal
Engineering Principles, LLC

Then appeared the above-named William W. Van Arsdell known to me and swore to the truth of the above statements before me,

Notary Public

My Commission Expires:

ANDREW MINTON
Notary Public
Commonwealth of Massachusetts
My Commission Expires July 27, 2023

Exhibit A

ENGINEERING PRINCIPLES®

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August 31, 2018

Mr. David Rogers, Esq.
Campbell Campbell Edwards and Conroy
One Constitution Plaza
Boston, Massachusetts 02129

Re: Kashper v. Toyota

Dear Mr. Rogers,

At your request, Engineering Principles®, LLC has performed certain investigations regarding the motor vehicle collision involving Konstantin Kashper. The purpose of this letter is to report the results of my investigations to date. In general, I anticipate offering testimony in the areas of mechanical engineering and the design, operation, usage, and performance of occupant protection systems. Engineering Principles, LLC bills $550 per hour for my consulting services.

QUALIFICATIONS AND METHODOLOGY

My expertise is in the discipline of mechanical engineering, including the fields of occupant crash protection, accident reconstruction, mechanics, materials, and design. I have extensive experience evaluating the performance of occupant protection systems including, but not limited to, seat belts, airbags, seats, child restraint systems, and the crashworthiness of motor vehicles. I have conducted over one hundred full-scale vehicle crash tests and sled tests and reviewed thousands of additional crash and sled tests. I have evaluated and tested over one thousand seat belts and have investigated hundreds of motor vehicle collisions. My research addresses occupant protection, occupant kinematics, accident reconstruction, mechanics, material selection, and the deformation, fatigue and fracture of materials.

I have a Ph.D. in Mechanical Engineering from the Massachusetts Institute of Technology, a M.S. in Mechanical Engineering from the University of Illinois at Urbana-Champaign, and a B.S. in Mechanical Engineering from the University of Arizona. As a graduate student, I have taught mechanics and materials at the University of Illinois at Urbana-Champaign. I am a NHTSA certified Child Passenger Safety Technician. I have successfully completed a Traffic Accident Reconstruction Training course at Northwestern University.

The generally accepted methodology for evaluating the design, safety and performance of occupant restraint systems includes analysis of factors and background such as dynamic testing, government standards, peer products, industry practices, field performance and technical work published in the literature, particularly as of the time a product is designed. In addition, the benefits and drawbacks of designs in real world applications should be considered. For this matter, I have evaluated the forensic evidence, available test data, literature, carefully considered all reasonable hypotheses, and considered plaintiff expert theories, to reach my opinions and conclusions. Appendix A includes a list of materials that I have reviewed as part of my investigation. This is the same methodology used by myself for previous matters and by other experts and knowledgeable persons in the field of occupant protection research.

SUBJECT COLLISION

On January 26, 2017, Mr. Konstantin Kashper was the driver and sole occupant of a 2016 Toyota Tacoma traveling on I-495. His vehicle reportedly went off of the side of the roadway and subsequently rolled over. The vehicle was found on its roof at point of rest. Mr. Kashper sustained fatal injuries.

PLAINTIFF'S CLAIMS

In his undated report, Dr. Ziejewski, a consultant retained by Plaintiffs, makes several broad claims about restraint technology without offering data, literature, testing or examples to support or illustrate these claims.

He states that "false latch"[1] is possible with seat belt buckles but does not seem to have evaluated either the subject buckle or the subject buckle design. He does not mention what seat belt buckles, if any, he has evaluated for partial engagement ("false latch"). He does not define what his criteria or protocol would be for evaluating partial engagement in seat belt buckles. He states a "properly designed and manufactured seat belt will not false latch," but he does not provide an example for the make and model of any "properly" designed seat belt. He does not explicitly state that the Tacoma buckle is not a properly designed one. He does not explicitly state that the subject Tacoma buckle either was partially engaged ("false latched") at the time the subject rollover sequence happened, or if the Tacoma buckle design is prone to partial engagement.

Dr. Ziejewski also opines that electronic data recorder (EDR) "information are not 100% correct," but does not define or explain what he means. He does not explain if he has concerns with specific EDR fields in the download, or all EDR fields. He does not provide any technical basis whatsoever (including but not limited to literature, analysis, data, testing, industry or government reports, or even anecdotal examples) for his claim that the information is "not

[1] While Dr. Ziejewski uses the term "false latch", the proper term to describe a buckle that may not be fully latched is "partial engagement" as defined by FMVSS 209, and as discussed in more detail elsewhere in this report.

100% correct." Dr. Ziejewski has relied on EDR data in other cases without noting such a broad criticism. He does not provide any evidence that either the subject EDR design or the specific subject EDR module had any documented issue, or that it would present data that is not "correct". He does not refer to any literature that an EDR record of belt status ("ON" / "OFF", or buckled / unbuckled) has been an issue, or shown to be faulty. He relies only on testimony of one person, Mr. Kashper's wife, that Mr. Kashper "always" wore his seat belt.

Dr. Ziejewski states the subject "vehicle struck the rock wall at a speed of 31 mph and rolled over." He does not state his basis for this speed. However, the EDR does indicate a speed of 31 mph just before the rollover (TRG 5); perhaps Dr. Ziejewski is selectively relying on the EDR data.

EVENT DATA RECORDER (EDR)

The Event Data Recorder (EDR) of the subject Tacoma was downloaded (see Figure 1 for excerpts; the complete 38 page report is in my file). The EDR has recorded four events (the most recent event, and 3 events prior). The earliest event recorded (3rd Prior event, TRG 2) was more than 16 seconds and 117 ignition cycles before the subject event and is not related to the subject deployment crash sequence (the latest 3 events are all at ignition cycle 835, while TRG 2 is at ignition cycle 718). In all of the subject event records, the EDR shows that the driver seat belt was unbuckled, consistent with the physical evidence[2]. In the EDR report, there were no diagnostic trouble codes (DTCs) recorded for any event. The EDR confirms a side curtain rollover airbag (SCRA) deploy signal was sent, and a pretensioner deploy signal was sent, consistent with physical evidence. The download also includes information with respect to vehicle acceleration, delta-V, roll-rates, vehicle speeds, accelerator and throttle conditions, among numerous other data. All of this data is useful in helping to understand the subject crash.

[2] For the 3rd prior event, TRG 2, 117 ignition cycles earlier, the EDR also shows the driver seat unbuckled.

System Status at Time of Retrieval

ECU Part Number	89170-04661
EDR Generation	13EDR
Complete File Recorded	Yes
Freeze Signal	ON
Freeze Signal Factor	Rollover CSA Deployment
Diagnostic Trouble Codes Exist	No
Ignition Cycle ,Download (times)	847
Multi-event, number of events (times)	2 or greater
Time from event 1 to 2 (s)	-0.019
Time from Previous Pre Crash TRG (msec)	16381 or greater
Latest Pre-Crash Page	0
Contains Unlinked Pre-Crash Data	No

Event Record Summary at Retrieval

Events Recorded	TRG Count	Crash Type	Time (msec)	Pre-Crash & DTC Data Recording Status	Event & Crash Pulse Data Recording Status
Most Recent Event	5	Front/Rear Crash	0	Complete (Page 0)	Complete (Front/Rear Page 0)
1st Prior Event	4	Rollover	19	Complete (Page 0)	Complete (Rollover Page 0)
2nd Prior Event	3	Side Crash	9	Complete (Page 0)	Complete (Side Page 0)
3rd Prior Event	2	Rollover	-16381 or greater	Complete (Page 1)	Complete (Rollover Page 1)

System Status at Event (Most Recent Event, TRG 5)

Recording Status, Front/Rear Crash Info.	Complete
Crash Type	Front/Rear Crash
TRG Count (times)	5
Previous Crash Type	Rollover
Time from Pre-Crash TRG (msec)	28
Linked Pre-Crash Page	0
Frontal Airbag Deployment, Time to 1st Stage Deployment, Driver (msec)	No
Frontal Airbag Deployment, Time to 1st Stage Deployment, Front Passenger (msec)	No
Pretensioner Deployment, Time to Fire, Driver (msec)	59
Pretensioner Deployment, Time to Fire, Front Passenger (msec)	No
Frontal Airbag Deployment, Time to 2nd Stage, Driver (msec)	N/A
Frontal Airbag Deployment, Time to 2nd Stage, Front Passenger (msec)	N/A
Active Head Restraint, Time to Deploy, Driver (msec)	SNA
Active Head Restraint, Time to Deploy, Front Passenger (msec)	SNA
Side Curtain Airbag Deployment, Time to Deploy, Driver (msec)	No
Side Curtain Airbag Deployment, Time to Deploy, Passenger (msec)	No
Side Airbag Deployment, Time to Deploy, Driver (msec)	No
Side Airbag Deployment, Time to Deploy, Passenger (msec)	No
Rear Window Airbag Deployment, Time to Deploy (msec)	SNA

DTCs Present at Time of Event (Most Recent Event, TRG 5)

Recording Status, Diagnostic	Complete
Ignition Cycle Since DTC was Set (times)	0
Airbag Warning Lamp ON Time Since DTC was Set (min)	0
Diagnostic Trouble Codes	None

Pre-Crash Data, 1 Sample (Most Recent Event, TRG 5)

Recording Status, Pre-Crash/Occupant	Complete
Time from Pre-Crash to TRG (msec)	100
TRG Count when Pre-crash TRG was Established (times)	3
Safety Belt Status, Driver	OFF
Safety Belt Status, Front Passenger	OFF
Occupant Size Classification, Front Passenger	Not Occupied
Frontal Airbag Suppression Switch Status, Front Passenger	SNA
RSCA Disable Switch	SNA
Seat Track Position Switch, Foremost, Status, Driver	No
Airbag Warning Lamp, On/Off	OFF
Ignition Cycle ,Crash (times)	835

System Status at Event (1st Prior Event, TRG 4)

Recording Status, Rollover Crash Info.	Complete
Crash Type	Rollover
TRG Count (times)	4
Previous Crash Type	Side Crash
Time from Pre-Crash TRG (msec)	10
Linked Pre-Crash Page	0
Side Curtain Airbag Deployment, Time to Deploy (msec)	1164
Pretensioner Deployment, Time to Fire, Driver (msec)	1164
Pretensioner Deployment, Time to Fire, Front Passenger (msec)	No

Pre-Crash Data, 1 Sample (1st Prior Event, TRG 4)

Recording Status, Pre-Crash/Occupant	Complete
Time from Pre-Crash to TRG (msec)	100
TRG Count when Pre-crash TRG was Established (times)	3
Safety Belt Status, Driver	OFF
Safety Belt Status, Front Passenger	OFF
Occupant Size Classification, Front Passenger	Not Occupied
Frontal Airbag Suppression Switch Status, Front Passenger	SNA
RSCA Disable Switch	SNA
Seat Track Position Switch, Foremost, Status, Driver	No
Airbag Warning Lamp, On/Off	OFF
Ignition Cycle ,Crash (times)	835

System Status at Event (2nd Prior Event, TRG 3)

Recording Status, Side Crash Info.	Complete
Crash Type	Side Crash
TRG Count (times)	3
Previous Crash Type	No Event
Time from Pre-Crash TRG (msec)	0
Linked Pre-Crash Page	0
Side Airbag Deployment, Time to Deploy (If Equipped) (msec)	No
Side Curtain Airbag Deployment, Time to Deploy (If Equipped) (msec)	No
Pretensioner Deployment, Time to Fire (msec)	No
Rear Window Airbag Deployment, Time to Deploy (msec)	SNA

Pre-Crash Data, 1 Sample (2nd Prior Event, TRG 3)

Recording Status, Pre-Crash/Occupant	Complete
Time from Pre-Crash to TRG (msec)	100
TRG Count when Pre-crash TRG was Established (times)	3
Safety Belt Status, Driver	OFF
Safety Belt Status, Front Passenger	OFF
Occupant Size Classification, Front Passenger	Not Occupied
Frontal Airbag Suppression Switch Status, Front Passenger	SNA
RSCA Disable Switch	SNA
Seat Track Position Switch, Foremost, Status, Driver	No
Airbag Warning Lamp, On/Off	OFF
Ignition Cycle ,Crash (times)	835

System Status at Event (3rd Prior Event, TRG 2)

Recording Status, Rollover Crash Info	Complete
Crash Type	Rollover
TRG Count (times)	2
Previous Crash Type	No Event
Time from Pre-Crash TRG (msec)	0
Linked Pre-Crash Page	1
Side Curtain Airbag Deployment, Time to Deploy (msec)	No
Pretensioner Deployment, Time to Fire, Driver (msec)	No
Pretensioner Deployment, Time to Fire, Front Passenger (msec)	No

Pre-Crash Data, 1 Sample (3rd Prior Event, TRG 2)

Recording Status, Pre-Crash/Occupant	Complete
Time from Pre-Crash to TRG (msec)	200
TRG Count when Pre-crash TRG was Established (times)	2
Safety Belt Status, Driver	OFF
Safety Belt Status, Front Passenger	OFF
Occupant Size Classification, Front Passenger	Not Occupied
Frontal Airbag Suppression Switch Status, Front Passenger	SNA
RSCA Disable Switch	SNA
Seat Track Position Switch, Foremost, Status, Driver	No
Airbag Warning Lamp, On/Off	OFF
Ignition Cycle ,Crash (times)	718

Figure 1: Subject 2016 Toyota Tacoma EDR download

VEHICLE INSPECTIONS AND PHYSICAL EVIDENCE

On May 7, 2018, I personally inspected the subject vehicle in Mendon, Massachusetts. The subject vehicle is a 2016 Toyota Tacoma access cab pickup (VIN 5TFSX5EN5GX046995) that is equipped with an aftermarket a bed cap and work rack. The driver's door window glass is intact, with the driver-side access door quarter-window glass not intact. The right-front passenger door window and right-side access door quarter-window glass are not intact. The windshield is fractured with a large hole but remains attached to the windshield surround.

The driver and right-front passenger seat belt retractor/latch plate assemblies are mounted to their respective access doors on the driver and passenger sides of the vehicle. These are lap/shoulder belt assemblies with dual sensing retractors, equipped with pretensioners and load limiters. They have free-sliding latch plates and adjustable D-rings. The buckles are mounted to the seats with steel stalks. The driver's adjustable turning loop is in the full-down position. The driver's seat belt is in the stowed position. The driver seat retractor pretensioner is

deployed, with the retractor locked and jammed, so that the webbing is pulled tight against the door and will not extract or retract. There are marks consistent with pretensioner deployment on the D-ring. There are no occupant load marks visible on the webbing, D-ring or latch-plate. There is a deposit on the webbing where the latch plate has settled above the stop button.

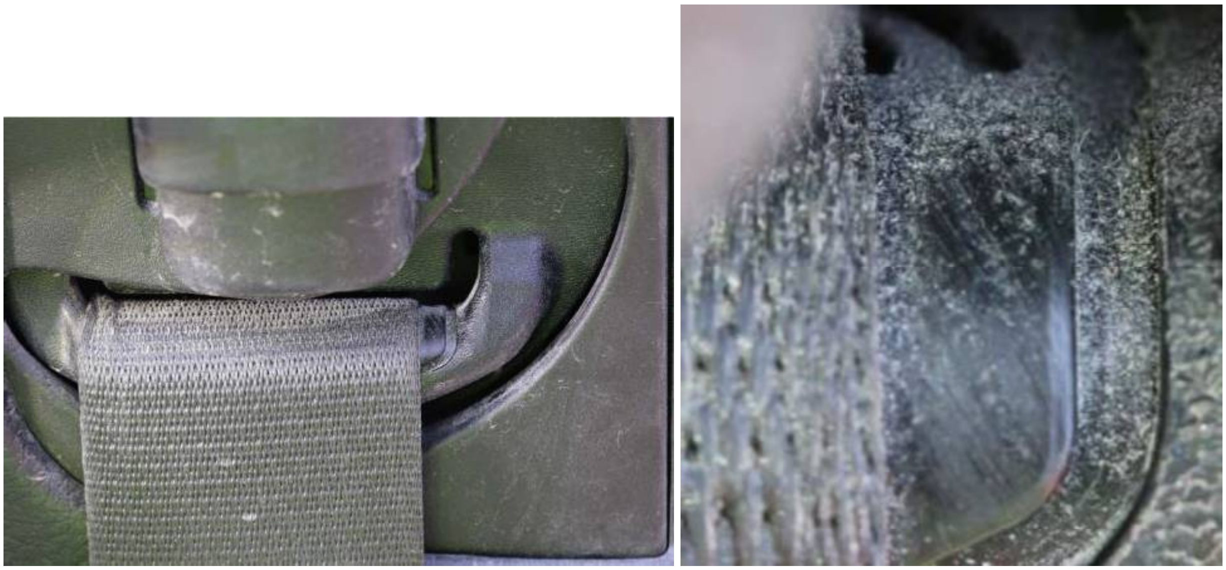

Figure 2a: Driver D-ring

Both the driver and right-front passenger roof rail mounted side curtains are deployed. The driver and passenger frontal airbag, the driver knee airbag, and the seat-mounted side airbags are not deployed.

The subject seat belt and buckle are manufactured by TRQSS (retractor assembly model A1501-P, buckle model B620). During my vehicle inspection, I evaluated the driver buckle latching function using the right-front passenger latch plate; the driver buckle functions properly and is not susceptible to partial engagement.

The subject buckle design is inherently resistant to partial engagement. I have thoroughly examined an exemplar service replacement buckle to analyze both the latching/unlatching mechanism and the buckle switch function, including disassembling this exemplar buckle (Figure 3). The buckle switch is a non-contact switch. Although it is clear that the subject buckle, and this buckle design in general are *not* prone to partial engagement, if somehow a partial engagement condition was achieved, this switch and buckle design would not indicate a status of unbuckled to the vehicle diagnostics even in this hypothetical partially engaged condition. The fact that the EDR indicates that the buckle was unbuckled at the time of the crash clearly indicates that the buckle was *neither* fully latched *nor* partially engaged at the time of the subject collision and rollover sequence.

Figure 3: Photographs – 2016 Toyota Tacoma service replacement buckle, mechanism

DRIVE STUDY – INSTRUMENTED BUCKLE

Both in previous investigations and additionally as part of a peer-reviewed SAE paper[3], I have directed drive studies, in which forces on the buckle were measured during normal driving activities, such as accelerating, braking, reaching for the radio or turning to look at mirrors or rearward. These studies establish that the forces on the latch plate and buckle can easily exceed 5 pounds and can be as high as 20 to 30 pounds.

On August 23, 2018, working at DRE and using a protocol similar to that used in my peer-reviewed SAE paper I evaluated the subject buckle design in a buckled drive study[4]. An original equipment service replacement driver's seat belt buckle assembly was purchased from a Toyota dealership for a Toyota Tacoma. The buckle assembly was modified by attaching a full-bridge strain gage to the buckle's steel strap. The overall buckle assembly length was not changed. The buckle assembly with the strain gage was installed vehicle and a drive study was performed.

During the drive study, three video cameras were used. One was focused on the seat belt buckle, one was focused on the driver and one was mounted to the roof of the vehicle to show the view ahead of the vehicle. In addition to the force on the seat belt buckle, additional data was recorded including vehicle speed, vehicle acceleration, and vehicle location (using GPS). The driver was not familiar with the purpose of the study and was instructed to make adjustments to the seat, mirrors and steering wheel so that they could comfortably drive the vehicle. They were asked to put on their seat belt, make several adjustments to the radio, reach for the glove compartment, back out of a parking space and follow a predefined route. The route included low speed, and highway speed driving and a number of typical driving maneuvers including left turns, right turns, lane changes, and maneuvers representing a three point turn and parking operations. During this drive study seat belt buckle loads exceeded 5 pounds.

As discussed in further detail elsewhere in this report, Federal Motor Vehicle Safety Standard (FMVSS) 209 defines a latch plate that releases at less than 5 pounds as not being in a condition of partial engagement; therefore the fact that the forces on the latch plate regularly exceeded 5 pounds show, that if for some reason the subject seat belt buckle was not completely latched, then the seat belt latch plate would have separated from the buckle during normal driving conditions and Mr. Kashper would have become aware that the seat belt had not been fully latched.

NAÏVE BUCKLING

In other investigations and as part of my peer-reviewed SAE paper[5], I have directed "naïve" buckling studies in which adult drivers, unaware of the true purpose of the study, were asked to

[3] (2011) Van Arsdell, W. et al. "Buckle-latch Insertion Force and Belt Tension in Everyday Driving." SAE 2011-01-0267.
[4] See DRE report 2018-DRE-138PT
[5] Ibid. (2011) Van Arsdell

sit in a vehicle and put their seat belt on. They were not given any specific instructions with respect to using their seat belts, other than to sit in vehicle and begin to prepare for a trip. I have also performed a similar study, not for litigation, and published these results in a peer-reviewed SAE paper.[6] As part of my investigation of the Kashper collision and rollover, I have performed similar work using an exemplar Toyota Tacoma.

On August 23, 2018, at Design Research Engineering (DRE), seventeen people were asked to sit in an exemplar Toyota Tacoma[7]. Their heights and weights were recorded. They were told that we were studying how people interact with the interior of the vehicle but *not* that this study was being done to evaluate seat belts or seat belt buckle function. They were asked to enter the vehicle three times, and each time to make adjustments to the seat and mirrors and put on their seat belt in order to prepare to drive the vehicle. The manner in which they latched the seat belt was recorded using two video cameras with audio. The forces they exerted on the buckle were measured using the same strain-gaged buckle that was used for the drive study. See Figure 4a for an example of the forces measured as the first naïve subject latched the buckle 3 times; and Figure 4b provides a more focused view of the data for just the first event. Figure 5 is a summary of the peak forces these 17 occupants exerted on the buckle during their latching events.

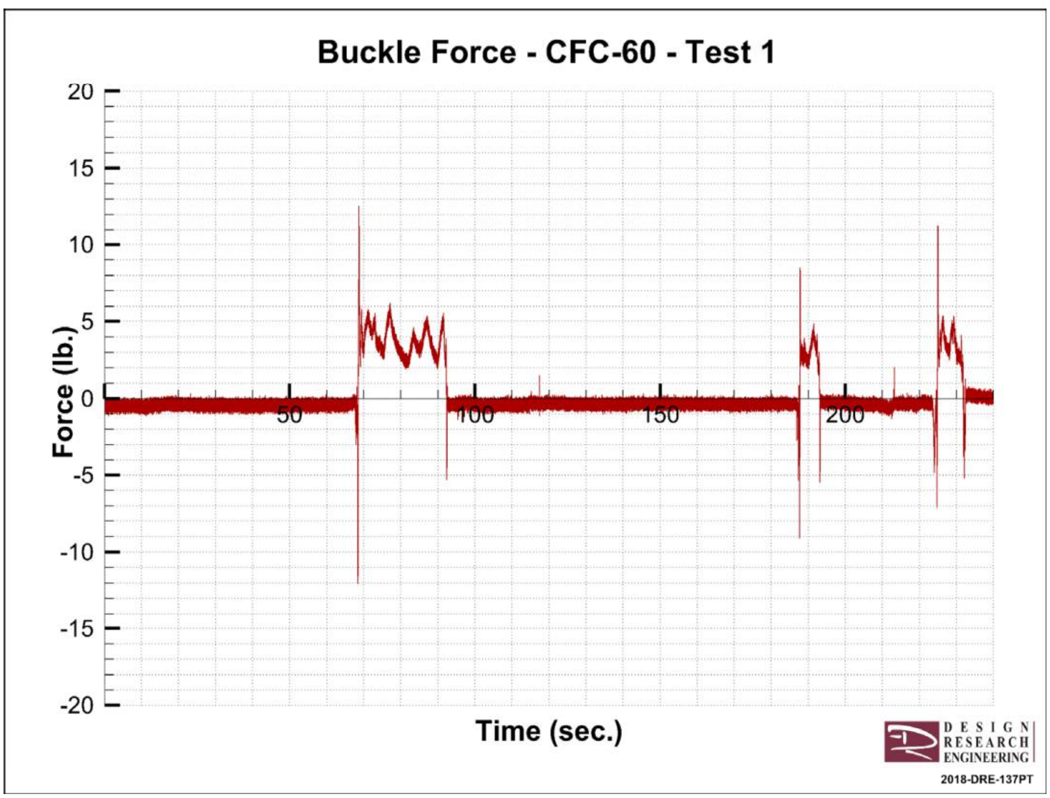

Figure 4a: Naïve subject 1- all 3 buckle latchings

[6] Ibid. (2011) Van Arsdell
[7] See DRE Report 2018-DRE-137PT, data and videos

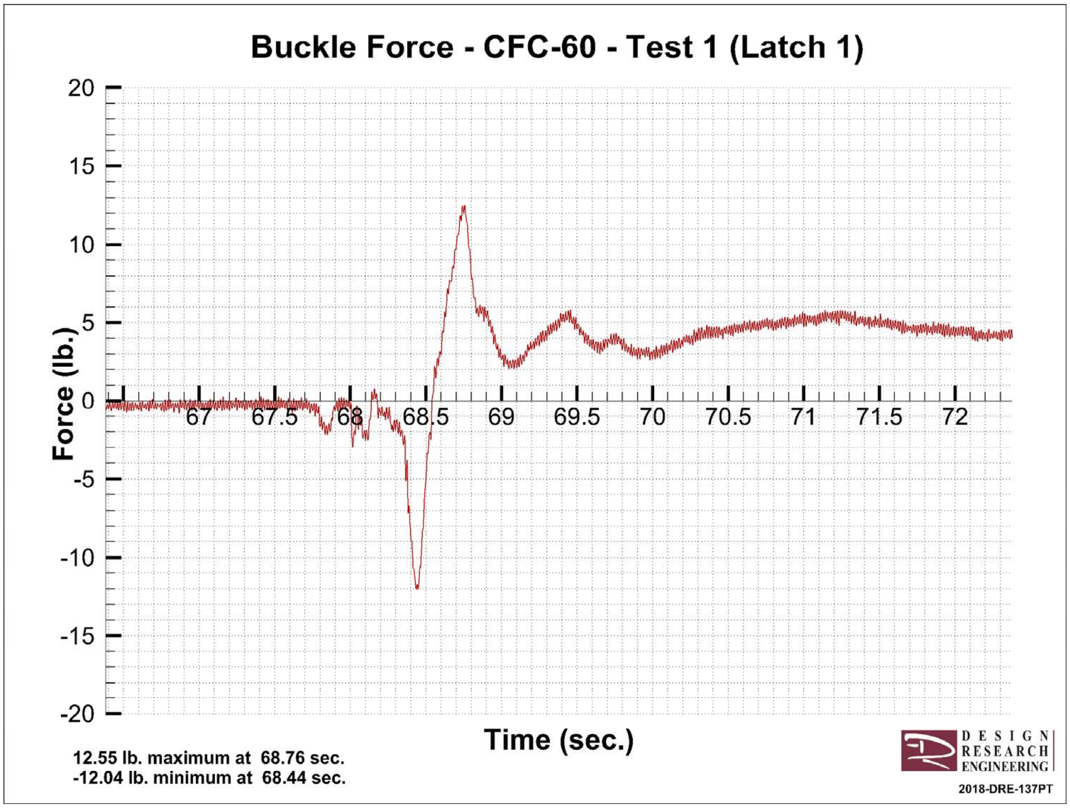

Figure 4b: Naïve subject 1- detail of first latching

Surrogate/Test Number	Latch 1 (Compression/Tension)	Latch 2 (Compression/Tension)	Latch 3 (Compression/Tension)
1	-12.0 / 12.6 lb.	-9.1 / 8.5 lb.	-7.1 / 11.3 lb.
2	-5.5 / 1.9 lb.	-7.2 / 2.3 lb.	-11.6 / 3.3 lb.
3	-8.8 / 3.0 lb.	-4.1 / 2.3 lb.	-5.6 / 11.9 lb.
4	-7.8 / 6.1 lb.	-7.1 / 3.3 lb.	-7.6 / 3.6 lb.
5	-8.2 /3.1 lb.	-4.6 / 3.1 lb.	-6.4 / 4.7 lb.
6	-12.5 / 6.7 lb.	-8.8 / 6.1 lb.	-8.2 / 5.5 lb.
7	-8.9 / 6.0 lb.	-5.6 / 5.1 lb.	-7.7 / 4.2 lb.
8	-11.0 / 10.2 lb.	-15.3 / 4.0 lb.	-19.1 / 2.7 lb.
9	-7.4 / 34.6 lb.	-7.2 / 9.0 lb.	-6.4 / 4.1 lb.
10	-9.7 / 2.4 lb.	-8.2 / 2.5 lb.	-9.5 / 2.6 lb.
11	-8.7 / 1.5 lb.	-10.3 / 2.4 lb.	-9.2 / 2.7 lb.
12	-8.4 / 9.7 lb.	-9.1 / 11. 6 lb.	-7.9 / 7.3 lb.
13	-8.6 / 16.3 lb.	-9.3 / 6.8 lb.	-8.0 / 5.4 lb.
14	-6.2 / 6.9 lb.	-6.0 / 5.2 lb.	-10.9 / 6.2 lb.
15	-16.2 / 3.3 lb.	-8.3 / 4.3 lb.	-7.5 / 4.2 lb.
16	-13.4 / 20.0 lb.	-15.3 / 25.2 lb.	-10.9 / 26.7 lb.
17	-19.8 / 5.3 lb.	-12.3 / 9.9 lb.	-17.4 / 7.8 lb.

Figure 5: Summary of peak latching forces

This work confirms that while different people use different techniques when donning their seat belts, all users exerted more than enough force to fully latch the subject buckle design. This latching force is also applied relatively quickly as compared to the slow deliberate insertion that is required to partially latch a buckle that may be prone to partial engagement. This work demonstrates techniques representative of actual use to latch a seat belt buckle.

As discussed in further detail elsewhere in this report, this established that users when latching the buckle with a technique representative of actual use will exert enough force to securely latch the subject buckle design and often tug on the latch plate with sufficient force (over 5 pounds) such that the latch plate would separate from the buckle if the buckle was not fully latched.

I also evaluated when the seat belt warning system was disabled as a latch plate was inserted into the buckle.[8] I found that the warning system is disabled after the latch plate is inserted into the buckle, but well before the buckle is latched. Although the subject buckle specifically and the buckle design in general are not prone to partial engagement, if (hypothetically) the buckle were somehow in a condition of partial engagement, this would occur when the buckle was almost fully inserted into the buckle. My evaluation of the buckle warning system (controlled by the buckle switch) clearly shows that the buckle status would be recorded as

[8] See DRE Report 2018-DRE-137PT, Test 18, data and videos

buckled even if the buckle was partially engaged. Therefore, the fact that the EDR recorded the buckle status during the subject collision and rollover sequence as unbuckled proves that the buckle could not have been either fully engaged or partially engaged and that Mr. Kashper was therefore not wearing his seat belt at the time of this crash.

DRIVE STUDY – UNBUCKLED DRIVER

On August 24, 2018 with the assistance of Design Research Engineering (DRE) at a controlled test and race track in Michigan, an unbuckled drive study was conducted in an exemplar Toyota Tacoma pickup[9]. The driver was unbuckled and the status of the warning light and chime/buzzer were monitored with a video camera that recorded both video and sound. A second video camera on the roof showed the view of the track ahead of the vehicle. A GPS system was used to independently monitor speed and position. The video and data demonstrates the time when the warning buzzer and status of warning light changed.

EXEMPLAR PRETENSIONER DEMONSTRATION

On August 23, 2018, at DRE, I conducted two pretensioner deployments.[10] In the first deployment, a 50th percentile HIII anthropometric test device (ATD) was seated in an exemplar Toyota Tacoma, with its left hand on the steering wheel. The right arm was placed on the arm rest to allow for a clear view of the buckle. The seat belt was properly routed over the ATD's torso and lap/pelvis. The latch-plate was taped to the buckle cover to simulate a buckle that was somehow in a condition of partial engagement ("false latched"). The pretensioner was deployed. The event was recorded with both high-speed and real-time video. When the pretensioner was deployed, the webbing was partially retracted but did not return to the stowed position (Figure 6). At the end of the demonstration, the seat belt was partially extended and was still draped around the ATDs left arm. The retractor was not jammed (i.e. webbing would still retract). This ***is not consistent*** with the condition in which Mr. Kashper's seat belt was found. Mr. Kashper's seat belt was found fully stowed and pulled tight against the interior trim of the vehicle with a locked and jammed retractor.

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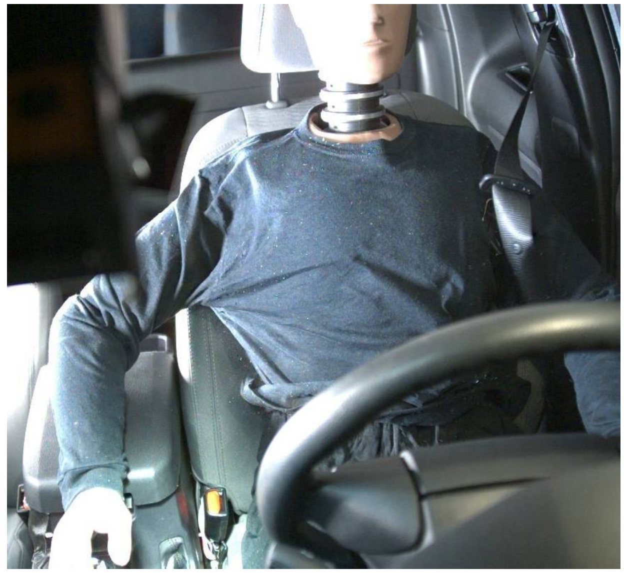
[9] See DRE Report 2018-DRE-140PT

[10] See DRE videos 2018-DRE-139PT



Pre deployment of pretensioner *Post deployment of pretensioner*

Figure 6: Still frame images from pretensioner deployment with taped latch-plate buckle

After replacing the seat belt with a new service replacement seat belt, a second demonstration was conducted. I deployed the driver pretensioner with the belt in the stowed position. In this second demonstration, the seat belt was pulled tight against the interior trim of the vehicle and retractor was locked and jammed. This ***is consistent*** with the condition of Mr. Kashper's seat belt at the end of his collision and rollover sequence and further proves that Mr. Kashper was not wearing his seat belt at the time of this crash. (The high-speed video for each of these tests is in my file).

As discussed elsewhere in this report, the fact that Mr. Kashper's seat belt was found locked and jammed with the webbing tight against the interior trim of the vehicle in a stowed condition clearly shows that Mr. Kashper was not wearing his seat belt when the pretensioner deployed in the subject crash.

SURROGATE STUDY

Also on August 23, 2018, I conducted a surrogate study at DRE with an exemplar 2016 Toyota Tacoma and a surrogate that was similar in height and weight to Mr. Kashper. Dr. Richard Evans, the county coroner who conducted Mr. Kashper's autopsy, testified that Mr. Kashper was 5 foot 6 inches, weighing 211 pounds. My male surrogate was about 5 foot 6.5 inches tall and weighed approximately 232 pounds. The driver seat and D-ring (ATL) were adjusted to the position as found during my vehicle inspection. The ATL was in the lowest position.

The surrogate was properly positioned in the driver seat and restrained with a properly positioned and snug seat belt (Figure 7). When properly positioned and buckled, the Toyota Tacoma seat belt provides good fit for an occupant the size of Mr. Kashper.

Figure 7: Surrogate Photographs

TESTIMONY

Anna Kashper

Dr. Ziejewski seems to rely exclusively on the testimony of Anna Kashper that Mr. Kashper was likely buckled at the time of the crash sequence. Although Ms. Kashper did testify that Mr. Kashper typically wore his seatbelt in his personal vehicles, she testified[11] that she was personally unaware of Mr. Kashper's seat belt use in the Tacoma, his work vehicle:

Page	Line
58	8 Q. Did you ever ride in the Tacoma?
	9 A. No.

[11] Deposition of Anna V. Kashper, June 25, 2018

19 Q. So it's fair to say you were never in that
20 vehicle with Konstantin when he drove it?
21 A. No.

59 20 Q. Do you know whether he used a seatbelt
21 while he was driving in the Tacoma?
22 A. I don't know.
23 Q. Did you and he ever talk about it?
24 A. No.

FEDERAL MOTOR VEHICLE SAFETY STANDARD (FMVSS) TESTING

For over 50 years, the United States Department of Transportation (DOT) has worked to ensure that "that the public is protected against unreasonable risk of accidents occurring as a result of the design, construction or performance of motor vehicles and is also protected against unreasonable risk of death or injury to persons in the event accidents do occur."[12] This is the responsibility of the National Highway Traffic Safety Administration's (NHTSA), a division of the DOT. To this end, NHTSA developed numerous Federal Motor Vehicle Safety Standards (FMVSSs) that all U.S. sold passenger vehicles must comply with. Vehicles that comply with these FMVSS have been shown to be highly effective in reducing the likelihood of serious injuries and fatalities in reasonably foreseeable motor vehicle accidents. Any suggestion that the FMVSS are minimally effective in protecting occupants from injury or death is unfounded and misleading. The FMVSSs consist of a set of specified tests that, generally speaking, evaluate the vehicle or its components relative to design and performance requirements. FMVSS 208 consists of a suite of tests that evaluates, among other things, driver and right-front passenger belted and unbelted performance in frontal collisions. FMVSS 209 tests and evaluates all vehicle seat belt assemblies at the component level. FMVSS 210 evaluates the integrity of all seat belt anchorages in a vehicle.

The subject seat belt was thoroughly and appropriately tested by Toyota beyond the requirements of the relevant FMVSSs, including FMVSSs 208, 209 and 210. The subject seat belt provides a reasonable level of protection in reasonably foreseeable collisions and rollovers, complies with all applicable FMVSSs, and is not defective. It has been shown in a number of studies that seat belts that comply with FMVSSs are highly effective in reducing injuries and death in reasonably foreseeable motor vehicle accidents. [13, 14, 15, 16, 17, 18, 19, 20]

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[12] (1966) Congress Public Law 89-563.
[13] (1984) Kahane, C. "Final Regulatory Impact Analysis, Amendment to Federal Motor Vehicle Safety Standard 208, Passenger Car Front Seat Occupant Protection." NHTSA DOT HS 806 572.
[14] (1990) Partyka, S. "Comparisons of Belt Effectiveness in Preventing Chest, Head and Face Injury in Front and Rear Impacts - Report." NHTSA Docket NHTSA-1998-4047.
[15] (1992) NHTSA "Evaluation of Effectiveness of Occupant Protection (Final Regulatory Impact Analysis)." NHTSA
[16] (1993) NHTSA. "First Report to Congress on Effectiveness of Occupant Protection Systems." NHTSA, DOT HS 808 019.
[17] (1996) NHTSA "NHTSA 2nd Report to Congress on Effectiveness of Occupant Protection Systems." NHTSA.

All FMVSSs are continually reviewed and updated by NHTSA. Publication of a proposed update is followed by an open comment period, where input and feedback are given by the automotive industry, research and educational institutions, engineering organizations and the general public. As stated in the Congressional law that enacted the FMVSSs, these standards were developed to ensure "that the public is protected against unreasonable risk of accidents occurring as a result of the design, construction or performance of motor vehicles and is also protected against unreasonable risk of death or injury to persons in the event accidents do occur." [21]

The Toyota Tacoma has been tested to ensure compliance with the FMVSSs. Full barrier tests have been conducted to demonstrate effective occupant protection in frontal collisions at 0 degrees, 30 degrees to the left (barrier rotated counter clockwise as viewed from above), and 30 degrees to the right. Tests have been run to show good performance in offset collisions and side impacts. The 2016 Toyota Tacoma was certified to the requirements of the FMVSS 208 and was tested in a number of test modes, including 25 mph offset deformable barrier (ODB), 30 mph flat and angled barriers, and 35 mph frontal barrier[22].

The 2016 Toyota Tacoma occupant restraint system, including the seat belt, complies with all applicable FMVSSs. Materials produced by Toyota show that the seat belts meet or exceed the requirements of FMVSS 209. The occupant restraint system, including but not limited to the vehicle's seat belts, meets or exceeds the requirements of FMVSS 208, and the seat belt anchorages meet the requirements of FMVSS 210.[23]

Seat belts have been shown to be highly effective in reducing the risk of injuries and fatalities in all types of motor vehicle accidents. It is well established in the literature, by NHTSA and by researchers that the primary occupant restraint device is the seat belt. Obviously, for seat belts to be effective, they must be worn and worn properly. Seat belted occupants are significantly less likely than unrestrained occupants to be seriously injured or killed during a

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[18] (2000) Kahane, C. "Fatality Reduction By Safety Belts for Front-seat Occupants of Cars and Light Trucks." NHTSA DOT HS 809 199.
[19] (2004) Kahane, C. "Lives Saved by the Federal Motor Vehicle Safety Standards and Other Vehicle Safety Technologies, 1960-2002." NHTSA, DOT HS 809 833.
[20] (2015) Kahane, C. "Lives Saved by Vehicle Safety Technologies and Associated Federal Motor Vehicle Safety Standards, 1960 to 2012" NHTSA, DOT HS 812 069.
[21] (1966) US Congress Public Law 89-563.
[22] Partial, non-exhaustive list includes: TOY-KASHPER-00016400, TOY-KASHPER-00016418, TOY-KASHPER-00016436, TOY-KASHPER-00016459, TOY-KASHPER-00016482, TOY-KASHPER-00016504, TOY-KASHPER-00016526, TOY-KASHPER-00016548, TOY-KASHPER-00016565, TOY-KASHPER-00016587, TOY-KASHPER-00016609, TOY-KASHPER-00016631, TOY-KASHPER-00016653, TOY-KASHPER-00016675, TOY-KASHPER-00016697, TOY-KASHPER-00016718, TOY-KASHPER-00016724, TOY-KASHPER-00016730. Other relevant materials reviewed and relied upon are listed in "_TMC Letter Production" Sections II, V, VI, VIII and X.
[23] TOY-KASHPER-00017051, TOY-KASHPER-00017064, TOY-KASHPER-00017072, TOY-KASHPER-00017074, and including references in (22) as well.

rollover.[24] However, no seat belt or any occupant restraint system can prevent all injuries in all collisions and rollovers.

Neither in 2016 nor currently is there an occupant protection rollover requirement in the FMVSSs, nor is there a standardized industry test to evaluate occupant protection in actual vehicle rollovers. Rollover testing presents many challenges. Rollover tests typically do not produce repeatable results even when identical vehicles are rolled under virtually identical conditions. By conducting testing of the subject generation Toyota Tacoma in rollover tests, and including rollover activated safety devices Toyota exceeded the regulatory requirements. However, as discussed elsewhere in this report, the primary safety device in any crash is the vehicle seat belt; clearly it must be worn, and worn correctly, in order to be effective.

DISCUSSION

Seat Belt Physical Evidence

From conversations with Mr. Don Tandy regarding his reconstruction of this collision and rollover sequence, the subject crash sequence consisted of a frontal impact and rollover. His reconstruction is consistent with the EDR data. Per Mr. Tandy's reconstruction, the subject Tacoma struck the rock wall at speed of 27 to 34 mph, and subsequently rolled (1/2 roll) onto its roof.

The fact that the seat belt is stowed, locked and jammed as well as the marks on the webbing, D-ring and latch plate show that Mr. Kashper was not wearing his seat belt at the onset of the crash. The literature contains numerous examples of how engineering analysis of seat belt marks can be used to reliably determine if and how a seat belt was worn and how the seat belt performed in a collision.[25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40] I have published a peer-reviewed

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[24] Ibid (2000) Kahane,
[25] (1977) Adomeit, D. et al. "Expected Belt Specific Injury Patterns Dependent on the Angle of Impact." 3rd International Conference on Impact Trauma.
[26] (1984) Moffatt, C. et al. "Diagnosis of Seat Belt Usage in Accidents." SAE 840396.
[27] (1990) Cromack, J. et al. "Occupant Kinematics & Belt Tests with Unrestrained and Partially Restrained Test Dummies." AAAM.
[28] (1990) Gorski, Z. et al. "Examination and Analysis of Seat Belt Loading Marks." Journal of Forensic Sciences 1990 Jan,35(1):69-79.
[29] (1999) Bready, J. et al. "Seat Belt Survey: Identification and Assessment of Noncollision Markings." SAE 1999-01-0441.
[30] (2000) Bready, J. "Characteristics of Seat Belt Restraint System Markings." SAE 2000-01-1317.
[31] (2006) Tanner, C. et al. "Automotive Restraint Loading Evidence for Moderate Speed Impacts and a Variety of Restraint Conditions." SAE 2006-01-0900.
[32] (2006) Davee, D. et al. "Case Study of Clothing Fabric Transfer to Seat Belt Webbing Under Accident Forces." SAE 2006-01-0904.
[33] (2006) Raymond, D. et al. "Forensic Determination of Seat Belt Usage in Automotive Collisions: Development of a Diagnostic Tool." SAE 2006-01-1128.
[34] (2006) Toomey, D. et al. "Safety Restraint System Physical Evidence and Biomechanical Injury Potential Due to Belt Entanglement." SAE 2006-01-1670.

paper looking at this subject.[41] When the webbing moves over a plastic surface (like the latch plate or D-ring) with sufficient speed and force, the plastic softens, and is pushed in the direction of loading and webbing movement. When the webbing movement reverses direction, multiple loading events may be detected on the latch plate.

I have evaluated the restraint systems in many vehicles subjected to rollovers, with both restrained and unrestrained occupants, and in both field studies and controlled testing. While it is true that restrained occupants sometimes leave less distinctive marks on the seatbelt webbing and hardware in rollovers as opposed to some planar (non-rollover) crashes, in virtually all rollovers that I have investigated with restrained occupants or dummies, there is typically some level of forensic marks created. There are no visible marks consistent with seat belt use in Mr. Kashper's seating position in the subject vehicle.

Pretensioners typically enhance the overall performance of the occupant protection system by tightening the seat belt early in a collision sequence. It is not unusual to deploy a pretensioner even if the seat belt is unbuckled. Toyota designed the subject seat belt pretensioner to deploy even if the seat belt is not being used. During the subject collision, the pretensioner deployed; the evidence proves that the pre-tensioner deployed with the seat belt in a stowed position. Following the collision sequence, the seat belt was pulled tight against the interior trim of the vehicle and the retractor was locked and jammed. This proves that Mr. Kashper was not wearing his seat belt at the time of this crash.

<u>Partial Engagement</u>

I have evaluated both the subject buckle in particular and the subject buckle design in general. During my vehicle inspection on May 7, 2018 I evaluated the subject driver's seat belt buckle that was available to Mr. Kashper. I operated Mr. Kashper's seat belt buckle (with the right-front passenger latch plate) and determined that it was ***not*** prone to partial engagement. I also performed testing at DRE on August 23, 2018 using an exemplar Tacoma seat belt buckle. I repeatedly attempted to partially engage the subject buckle design by slowly inserting the latch plate. I was not able to partially latch the exemplar seat belt buckle. Each time I attempted to partially latch the seat belt buckle one of two things occurred: either the buckle completely and securely latched, or the buckle did not latch and the ejector ejected the latch plate. The subject

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[35] (2007) Welsh, K. et al. "Restraint System Markings and Occupant Kinematics in Crash Tests with Disabled Seat Belt Restraint Systems." ASME.
[36] (2008) Heydinger, G. et al. "Comparison of Collision and Noncollision Marks on Vehicle Restraint Systems." SAE 2008-01-0160.
[37] (2009) Jenkins, J. et al. "Forensic Analysis of Seat Belt Retractor Torsion Bars." SAE 2009-01-1242
[38] (2009) Brown, J. et al. "Comparison of Restraint System Marks with Proper and Improper Belt Usage." SAE 2009-01-1243.
[39] (2009) Jakstis, M. et al. "Marks on Seat Belt Systems with Pretensioners and Force Limiters in Airbag Deployment Crashes." SAE 2009-01-1252.
[40] (2011) Hinger, J. "Methods for Evaluating Occupant Kinematics and Seatbelt Use During a Collision." ASME IMECE2011-64736.
[41] (2009) Burnett, R. et al. "Frontal Impact Rear Seatbelt Load Marks: An In-depth Analysis." SAE 2009-01-1249.

seat belt buckle design in general and Mr. Kashper's seat belt in particular are ***not*** susceptible to partial engagement ("false latch"). Dr. Ziejewski's suggestion that Mr. Kashper's seat belt buckle may have "false latched" is unfounded and has been proved incorrect by the EDR data as well as my evaluations discussed in this report and further detailed in my file materials.

As discussed elsewhere in this report, I have published a peer-reviewed paper on the subject of buckle insertion forces, including evaluating partial engagement, and the forces on a buckle under normal driving conditions[42]. FMVSS 209 specifies requirements for seat belt assemblies for use in passenger vehicles. Section S5.2(g) requires that the buckle be examined to determine whether partial engagement is possible "by means of any technique representative of actual use." Under FMVSS 209, if it is determined that partial engagement can be achieved by a means of any technique representative of actual use, then sections S4.3(g) and S5.2(g) specify that for this condition of "partial engagement" to be acceptable, a seat belt buckle must separate when a force of not more than five pounds is applied to the latch plate. This ensures that if a condition of partial engagement exists, the latch plate would likely separate from the buckle and would be easily detectable by the occupant under regular driving (non-collision) conditions. Five pounds is a reasonable limit to assess the level of buckle engagement, and a buckle complying with this limit will readily become detached under normal driving conditions and is therefore self-detecting.

To correctly determine whether or not there is a condition of partial engagement, the force to release the latch plate from the buckle must be measured, and then shown to be greater than five pounds. If the latch plate appears latched in the buckle, and releases with less than 5 pounds, the buckle is not in a state of partial engagement. Even when attempting to latch the subject buckle design with a technique that was *not* representative of actual use[43], I was unable to achieve a situation where the latch plate stayed in the buckle unlatched. As described in this report, and detailed in my file materials, the latch plate either latched fully in the buckle, or was ejected from the buckle by the ejector.

The naïve surrogate study I conducted for this matter, as well as similar work conducted for my SAE paper and in other matters, and as documented by other researchers in peer reviewed literature[44] validate the principle that seat belt buckles in general will latch with appropriate forces, and they are not susceptible to partial engagement when buckled by users, especially when latched with techniques representative of actual use.

Mr. Kashper was apparently driving on the interstate for at least several miles when the crash occurred. Prior to this crash, as Mr. Kashper left his parking site, drove to the interstate on-ramp, merged onto the interstate and travelled at highway speeds, it is extremely likely that at least five pounds of webbing tension would have developed on the buckle (if Mr. Kashper had been using his seat belt), based on work done for this matter with an instrumented driver buckle, as well as work done in other matters. If somehow, Mr. Kashper's buckle was partially

[42] Ibid. (2011) Van Arsdell
[43] Ibid DRE Report 2018-DRE-137PT, Test 18, data and videos
[44] (2007) Scher, I. et al. "The Influence of Age on the Forces Produced During Normal Seat Belt Buckling." ASME SBC2007-175551.

engaged as he left his parking site, as he drove to the scene of the crash, the seat belt tension would have been sufficient to pull the latch plate out of the buckle, the seat belt pressure on Mr. Kashper's body would have been relieved, the seat belt warning lamp and chime would have been turned on, and it would have been readily apparent to Mr. Kashper that the seat belt was not latched.

Based on testing and investigations conducted and reported in the literature as well as my Tacoma pretensioner deployment demonstrations discussed above, if Mr. Kashper had been wearing his seat belt and if somehow the seat belt buckle had become unlatched prior to or during the collision sequence, he would have become entangled in his seat belt during the frontal crash or the rollover. Entanglement would have created marks on both the seat belt and Mr. Kashper's body and the seat belt would not have been found fully stowed, tight up against the interior trim of the vehicle with a locked and jammed retractor (as discussed above). The seat belt webbing and hardware lack any evidence of entanglement, which would leave distinctive marks on the hardware and webbing. Per Dr. Raphael, Mr. Kashper had no evidence of belt entanglement injuries or marks on his body, nor did he have injuries or marks consistent with the seat belt being worn. The evidence on the seat belt and on the body when there is seat belt entanglement (with intentionally released seat belts) has been thoroughly discussed in the literature and in testing[45,46,47].

<u>Inertial Release and Inadvertent Contact</u>

While Dr. Ziejewski does not mention other possible theories of buckle release, he very broadly states "[if] Konstantin Kashper thought his seat belt was properly buckled and latched, and even if the cause of Konstantin Kashper to be unprotected *was something other than false latching*, the Vehicle was not fit for its purposes." [emphasis added] He may be implying other mechanisms of buckle release other than partial engagement (or false latch). In the past, some experts retained by other plaintiffs have alleged that a buckle may in some cases release by mechanisms referred to as inertial release and inadvertent contact.

For the purposes of this report, "inertial release" is defined as the release of the latch plate from a seat belt buckle due to acceleration. Seat belt buckles have an inherent resistance to inertial release. At any given webbing tension, a buckle will not release unless sufficiently high accelerations are experienced for a sufficient duration and in the proper direction. The buckle's inherent resistance to inertial release increases with higher webbing tension and shorter pulse duration. Properly restrained occupants load the seat belt, increase the webbing tension, and increase the friction within the buckle, thereby further increasing the buckle's resistance to inertial release. Dr. Ziejewski has not identified that the subject rollover has any, much less all, of the necessary and sufficient elements of direction, magnitude and duration to cause inertial

[45] (2006) Toomey, D. et al. "Safety Restraint System Physical Evidence and Biomechanical Injury Potential Due to Belt Entanglement." SAE 2006-01-1670.
[46] (2007) Raphael, E. et al. "Physical Evidence Associated with Seatbelt Entanglement During a Collision." SAE 2007-01-1501.
[47] (2008) Raasch, C. et al. "Seat Belt Entanglement in Rollover Accidents: Physical Evidence and Occupant Kinematics." SAE 2008-01-1237.

release. Multiple researchers[48,49,50,51,52] including myself [53,54] have demonstrated these fundamental principles in peer- reviewed, published research. Based on that body of literature, my previous research and investigations, and my review of Mr. Tandy's reconstruction of this collision and rollover sequence, the subject buckle could not have inertially released in the subject crash.

With respect to "inadvertent contact", for the purposes of this report, this is defined as unintended contact with and depression of the press button such that the latch plate is released from the buckle. I have published a peer-reviewed paper on the subject of seat belt buckle release by inadvertent contact[55] that examined this phenomenon and its likelihood. In order for release by inadvertent contact to occur, there must be contact of a sufficient duration and force to push the press button until it moves sufficiently to release the latched buckle. The presence of webbing tension, as occurs during motor vehicle accidents, including rollovers, increases the force and energy required to actuate the press button. Occupant kinematics and the likelihood of contact between an occupant's hand or arm and the press button also play a role. The subject collision sequence would not be expected to lead to occupant kinematics that would result in release by inadvertent contact. The forces acting on a vehicle during typical crashes or rollovers do not typically direct the hand or elbow "down" towards the press button in such a manner as to cause buckle release. The possibility of release by inadvertent contact must be balanced with the requirement of easy and rapid removal to maximize safety and promote seat belt usage. Based on the literature, my previous research and investigations, and my review of Mr. Tandy's reconstruction of this collision and rollover sequence, the subject buckle could not have released by inadvertent contact in the subject crash.

Furthermore, if somehow the buckle *had* inertially or inadvertently released during this crash, there would be evidence of entanglement on Mr. Kashper's body as well as the seat belt and the seat belt would not have been found tight up against the interior trim in a stowed condition with the retractor locked and jammed (as described elsewhere in this report, and as demonstrated in my belted pre-tensioner deployment).

[48] (1993) James, M. et al. "Inertial Seatbelt Release." SAE 930641.
[49] (1993) Moffatt, E. et al. "Studies on the Effects of Inertial Forces on the Seat Belt Buckle in Rollover Crash Tests." SAE Toptec.
[50] (1995) Moffatt, E. et al. "Safety Belt Buckle Inertial Responses in Laboratory and Crash Tests." SAE 950887.
[51] (2005) Bready, J. et al. "Issues in Seatbelt Inertial Release." SAE 2005-01-1706.
[52] (2005) Klima, M. et al. "Seat Belt Buckle Performance in High Energy Wheel-to-ground Impacts." SAE 2005-01-1709.
[53] (2004) Davee, D. et al. "Minimal Effect of Amplified Vehicle Accelerations on Seat Belt Buckle Resistance to Inertial Release." SAE 2004-01-0854.
[54] (2006) Cooper, E. et al. "Dynamic Response of End-release Buckles to Floor Anchor Impulses." SAE 2006-01-0915.
[55] (2008) Davee, D., Van Arsdell et al. "Seat Belt Buckle Release By Inadvertent Contact." SAE 2008-01-1236.

Event Data Recorders

The Tacoma event data recorder (EDR) is mounted along the centerline of the vehicle. Multiple events can be recorded. The EDR will record a trigger event when the vehicle undergoes forces that exceed a specified threshold, which is different depending if the crash is a frontal, side or rollover crash. This event (or algorithm enable) is not necessarily of a level that will deploy an airbag or pretensioner. The EDR data is 'frozen' after an airbag or pretensioner deployment and cannot be overwritten. If airbags or a pretensioner are not deployed, events may be overwritten if subsequent triggering events occur. Toyota EDRs do not record date or time stamps, but do record certain time intervals between trigger events, and the number of ignition cycles at the time of the event.

There is a substantial amount of literature and field data establishing that EDRs are highly reliable in general[56,57], and Toyota EDRs are reliable in particular[58,59,60,61,62,63, 64,65,66,67]. NHTSA has specifically evaluated whether Toyota EDRs have a defect and found that they do not.[68] While Dr. Ziejewski states EDR's are not 100% "correct", he provides no explanation of what he means by this; and offers no data or other foundational materials to support this. The literature referred to above also contains no examples that the buckle status ("ON" / "OFF") was recorded incorrectly either in the field or in testing.

The subject EDR download shows that in the second most recent event (TRG 4) the SCRA and pretensioner deployment signal was sent 1164 milliseconds (ms) after the rollover event initiated. In the "most recent" event (TRG 5), the frontal collision, the forces were sufficient to send a pretensioner deploy signal 59 ms after the frontal collision event initiated, but not severe enough to deploy the frontal airbags.

Seat Belt Warning System: Buzzer and Lamp

To encourage an unbuckled driver to wear the available seat belt, the 2016 Toyota Tacoma has an extended series of audible warnings (buzzers/chimes) as well as a warning lamp on the

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[56] (2013) Tsoi, A. et al. "Validation of Event Data Recorders in High Severity Full-frontal Crash Tests." SAE 2013-01-1265.
[57] (2011) German, A. et al. "Crash Pulse Data From Event Data Recorders in Rigid Barrier Tests." ESV 11-039
[58] (2011) Comeau, J. et al. "Event Data Recorders in Toyota Vehicles." 21st Canadian Road Safety Conference.
[59] (2011) "Testing and Analysis of Toyota Event Data Recorders." Exponent.
[60] (2012) Brown, R. et al. "Evaluation of Camry HS-CAN Pre-crash Data." SAE 2012-01-0996.
[61] (2011) "Toyota Pre-crash EDR Field Inspections During March - August 2010." NHTSA.
[62] (2012) Brown, R. et al. "Confirmation of Toyota EDR Pre-crash Data." SAE 2012-01-0998.
[63] (2012) Ruth, R. et al. "Accuracy of Event Data in the 2010 and 2011 Toyota Camry During Steady State and Braking Conditions." SAE 2012-01-0999.
[64] (2014) Tsoi, A. et al. "Validation of Event Data Recorders in Side-impact Crash Tests." SAE 2014-01-0503.
[65] (2014) Webster, G. et al. "Accuracy of Recorded Driver Inputs in Toyota Part 563 EDR." SAE 2014-01-0505.
[66] (2016) Iyoda, M. et al. "Event Data Recorder (EDR) Developed By Toyota Motor Corporation." SAE 2016-01-1495.
[67] (2016) Xing, P. et al. "Comparison of the Accuracy and Sensitivity of Generation 1,2 and 3 Toyota Event Data Recorders in Low-speed Collisions." SAE 2016-01-1494.
[68] (2016) Denial of Petition - Toyota EDR Defect. 81 FR 11353.

instrument panel. The Toyota Tacoma owner's manual describes the sequence of these warnings (see Figure 8). The unbelted drive study described above confirmed that the actual function of the subject Tacoma seat belt warning system is consistent with the description in the owner's manual. While these warnings are appropriate and effective, literature and research[69,70,71,72] has shown that while these enhanced series of warnings *do* increase belt use, there remains a population who do not heed these warning or use their available seat belts.

> 8-2. Steps to take in an emergency **515**
>
> *7: Driver's seat belt buzzer:
>
> The driver's seat belt buzzer sounds to alert the driver that his or her seat belt is not fastened. Once the engine switch is turned to the "ON" or "START" position mode, the buzzer sounds for 6 seconds. If the vehicle reaches a speed of 12 mph (20 km/h), the buzzer sounds once. If the seat belt is still unfastened after 24 seconds, the buzzer will sound intermittently for 10 seconds. Then, if the seat belt is still unfastened, the buzzer will sound in a different tone for 20 more seconds.

Figure 8: Excerpt from Toyota Tacoma Owner's Manual

NCAP / IIHS Testing

In addition to the FMVSSs that are developed and enforced by NHTSA, there are additional crash tests that are routinely conducted by NHTSA, the auto manufacturers and other organizations to help ensure that U.S. passenger vehicles provide a high level of occupant protection even in severe collisions. The most common consumer metric tests conducted are the New Car Assessment Program (NCAP) tests conducted by NHTSA and tests conducted by the Insurance Institute for Highway Safety (IIHS). I have reviewed both Toyota produced testing, and publicly available NHTSA[73] and IIHS[74] testing for the 2016 Tacoma series, and the Tacoma occupant restraint system provides effective occupant protection even under these very severe crash conditions. I am aware of no report of the subject buckle design being susceptible to partial engagement, or that the subject seat belt buckle design released unintentionally during any testing.

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69 (2002) Williams, A. et al. "Effectiveness of Ford's Belt Reminder System in Increasing Seat Belt Use." Injury Prev 8:293–296.
70 (2007) "The Effectiveness of Enhanced Seat Belt Reminder Systems. Observational Field Data Collection Methodology and Findings." NHTSA DOT HS 810 844.
71 (2007) "Acceptability and Potential Effectiveness of Enhanced Seat Belt Reminder System Features." NHTSA DOT HS 810 848.
72 (2009) "Effectiveness and Acceptance of Enhanced Seat Belt Reminder Systems: Characteristics of Optimal Reminder Systems." NHTSA DOT HS 811 09
73 NHTSA tests 9591, 9594, 9595
74 IIHS tests CEF1701, CEN1707, CEN1638, CES1702

<u>Recall History of Tacoma</u>

The 2016 Toyota Tacoma occupant protection system has been tested by NHTSA on numerous occasions. All NHTSA testing indicates that the occupant protection system, including the seat belts, perform well and comply with the performance requirements of the applicable FMVSSs. One of NHTSA's responsibilities is to work with the auto manufacturers to recall defective products. Each year NHTSA administers hundreds of recalls. The 2016 Toyota Tacoma seat belt system has never been the subject of a recall.

SUMMARY OF KEY CONCLUSIONS

Based on my background and experience in the areas of mechanical engineering and occupant restraint systems, and the materials reviewed to date, I have formed the above (contained in the body of this report) and following opinions to a reasonable degree of engineering certainty. As additional information becomes available, it may be necessary to continue my investigation and supplement or modify my opinions and conclusions.

1. Based on all available information (including the design and function of the seat belt and sensing systems, testing, analysis, EDR data, physical evidence, the literature and consultation with other experts), Mr. Kashper was not wearing his seat belt at the time of the subject crash.

2. The final condition of the driver seat belt is not consistent with seat belt buckle having been in a partially engaged condition immediately before the subject crash.

3. The final condition of the driver seat belt is not consistent with seat belt buckle having released by any mechanism immediately before or during the subject crash.

4. If the seat belt had been partially engaged and released, the seat belt would not have been found in a stowed condition tight against the interior trim with a locked and jammed retractor and there would be clear evidence of entanglement on both the seat belt and on Mr. Kashper's body.

5. The subject seat belt buckle is not prone to partial engagement ("false latch"). During my inspection of the subject vehicle, I was unable to partially latch the subject seat belt buckle.

6. The subject seat belt buckle design is not prone to partial engagement. During my testing and evaluations, I was unable to partially latch the subject seat belt buckle design; in this testing and evaluations, the buckle either fully latched or the latch plate was ejected by the ejector.

7. If Mr. Kashper had been properly positioned and wearing his seat belt properly, the occupant protection system would have performed well and reduced the risk of serious injury or death in motor vehicle crashes including rollover events.

8. The subject 2016 Toyota Tacoma occupant restraint system performed as designed in the subject crash.

9. The 2016 Toyota Tacoma driver occupant restraint system, including but not limited to the seat belt assembly, is appropriately designed and manufactured and is reasonably safe for its intended and foreseeable purposes. It is not defective and/or unreasonably dangerous.

10. The 2016 Toyota Tacoma driver occupant restraint system, including but not limited to the seat belt assembly, meets all relevant FMVSSs.

11. Occupant protection systems that comply with the FMVSSs have been shown to be highly effective in reducing the risk of injury and death in motor vehicle collisions.

12. Toyota conducted a reasonable amount of testing in the design and development of the 2016 Toyota Tacoma driver occupant restraint system, including but not limited to the seat belt assembly.

13. Testing shows good performance of the 2016 Tacoma driver occupant restraint system, including but not limited to the seat belt.

14. EDRs are considered a reliable source of crash data. There has been no data presented in this matter, or that I am aware of, that the EDR download for the subject crash is unreliable. In particular, I am not aware of any data that supports an opinion that the EDR data regarding Mr. Kashper's buckle status during this crash is incorrect.

15. The EDR data that indicates that Mr. Kashper was *not* wearing his seat belt at the time of this crash is reliable and correct.

16. The EDR data is consistent with the physical evidence, and the reconstruction of Mr. Tandy.

17. No occupant restraint system, including but not limited to the seat belt assembly, can prevent all injuries to all occupants in all motor vehicle accidents.

18. Seat belts must be used and used properly in order to provide occupant protection.

Sincerely,

Wm. W. Van Arsdell

William W. Van Arsdell, Ph.D., P.E.
Principal Engineer
Enclosures

<u>Appendix A: Materials Reviewed</u>

1. Court Documents:
    a. Kashper v. Enterprise Fleet Mgmt. et al. Complaint (Middlesex Superior Court)
    b. Judge's Order on The Parties Joint Statement Pursuant to Location
    c. Plaintiff's Response to RPD
    d. Plaintiff's Response to Def TMS First RPDs
    e. Plaintiff's Amended Response to Def TMS Second RPDs
    f. Plaintiff's Ans to TMS's First INTs

2. First Responder Reports:
    a. Massachusetts Motor Vehicle Crash Police Report
    b. MA State Police CARS Report
    c. MA State Police Crash Report
    d. Milford Fire Department Records

3. Photographs and Video:
    a. Barry Hare Site Inspection Photos
    b. Plaintiff Provided Photos 2017.11.16 and 2017.12.21
    c. MA State Police Photos
    d. MA State Police Crime Scene Photos
    e. DRE Photos, taken August 23, 3018
    f. Engineering Principle Vehicle Inspection Photos, taken May 7, 2018
    g. Engineering Principle Inspection Photos (exemplar buckle and DRE test articles), taken August 30, 2018

4. Depositions and Exhibits of:
    a. Cavanaugh, Sean, taken April 6, 2018
    b. Collins, William, taken June 7, 2018
    c. Detore, Michael, taken June 7, 2018
    d. Dzivasen, Kiel taken June 26, 2018
    e. Evans, Richard taken June 12, 2018
    f. Hare, Barry taken July 27, 2018
    g. Hunt, Timothy, taken April 6, 2018
    h. Kashper, Anna, taken June 25, 2018
    i. Kelley, Matthew, taken April 6, 2018
    j. McDonald, Steven, taken May 30, 2018
    k. Wollanski, Richard taken July 30, 2018

5. Expert Reports of:
    a. Peretti, Frank
    b. Feigen, Gerald
    c. Ziejewski, Mariusz

6. Testing:
    a. DRE Toyota Tacoma Evaluations, August 23, 24 2018
        i. Reports, photos, data and video

7. Production – Subject to Protective Order:
    a. TMC Letter Production
    b. TMS RPD Responses
    c. TMS Supp IDS
    d. TMS Supp IDS PO

8. Medical Records from:
    a. Milford Regional Medical Center Records
    b. Medical Examiner's Report

9. Miscellaneous:
    a. Bosch Crash Data Retrieval Report 5TFSX5EN5GX046995_ACM
    b. Tacoma Owner's Guides 2016-2018
    c. Tacoma Owner's Manuals 2016-2018
    d. Tacoma Sales Brochures 2016-2018
    e. 2017.04.27 Dealer Letter Safety Recall HOG
    f. Technical Instructions Safety Recall HOG
    g. Exemplar Toyota Tacoma buckle and retractor assemblies
    h. Naïve buckle studies from other matters
    i. Drive studies from other matters